

## Low-Voltage, Low $r_{ON}$ , Single Analog Switch In miniQFN-6 Package

### DESCRIPTION

The DG2511/DG2512/DG2513 are low on-resistance, single-pole/double-throw or single-pole/single-throw monolithic CMOS analog switch. It is designed for low voltage applications. The DG2511/DG2512/DG2513 are ideal for portable and battery powered equipment, requiring high performance and efficient use of board space. In addition to the low on-resistance ( $1.3 \Omega$  at 2.7 V).

The DG2511 is an SPDT and the DG2512/DG2513 are SPST. The switch conducts equally well in both directions when on, and blocks up to the power supply level when off.

The DG2511/DG2512/DG2513 are built on Vishay Siliconix's low voltage J15L process. An epitaxial layer prevents latchup.

Break-before-make is guaranteed.

The DG2511/DG2512/DG2513 represents a breakthrough in packaging development for analog switching products. The miniQFN-6 package ( $1.2 \times 1.0$  mm).

As a committed partner to the community and the environment, Vishay Siliconix manufactures this product with the lead (Pb)-free device terminations. For analog switching products manufactured with NiPdAu device terminations, the lead (Pb)-free "-E4" suffix is being used as a designator.

### FEATURES

- Low Voltage Operation (1.8 V to 5.5 V)
- Low On-Resistance -  $r_{ON}$ :  $1.3 \Omega$  at 2.7 V
- Low Charge Injection
- Low Voltage Logic Compatible
- miniQFN-6 Package ( $1.2 \times 1.0$  mm)



**RoHS**  
COMPLIANT

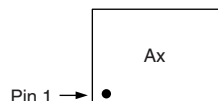
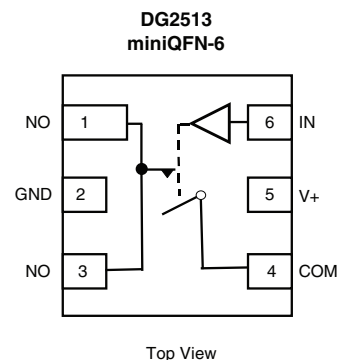
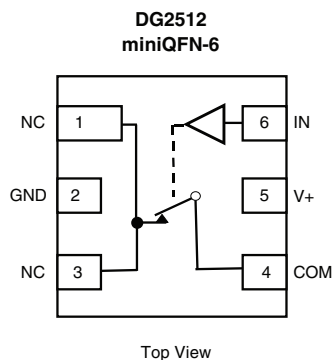
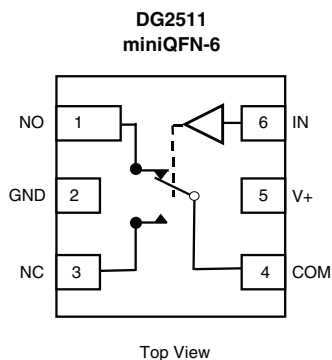
### BENEFITS

- Reduced Power Consumption
- Simple Logic Interface
- High Accuracy
- Reduce Board Space
- Guaranteed 2 V Operation

### APPLICATIONS

- Cellular Phones
- Communication Systems
- Portable Test Equipment
- Battery Operated Systems
- Sample and Hold Circuits
- ADC and DAC Applications
- Low Voltage Data Acquisition Systems

### FUNCTIONAL BLOCK DIAGRAM AND PIN CONFIGURATION



Device Marking: Ax for DG2511  
Bx for DG2512  
Cx for DG2513

x = Date/Lot Traceability Code  
Note: Pin 1 has long lead

### TRUTH TABLE

Logic	NC	NO
0	ON	OFF
1	OFF	ON

### COMMERCIAL ORDERING INFORMATION

Temp Range	Package	Part Number
- 40 to 85 °C	miniQFN-6 Lead (Pb)-free with Tape and Reel	DG2511DN-T1-E4 DG2512DN-T1-E4 DG2513DN-T1-E4

ABSOLUTE MAXIMUM RATINGS $T_A = 25^\circ\text{C}$ , unless otherwise noted				
Parameter	Symbol	Limit	Unit	
Reference $V_+$ to GND		- 0.3 to + 6	V	
IN, COM, NC, NO <sup>a</sup>		- 0.3 to ( $V_+ + 0.3$ V)		
Continuous Current (NO, NC, COM pins)		$\pm 150$	mA	
Peak Current (Pulsed at 1 ms, 10 % duty cycle)		$\pm 300$		
Storage Temperature	D Suffix	- 65 to 150	$^\circ\text{C}$	
Power Dissipation (Packages) <sup>b</sup>	miniQFN-6 <sup>c</sup>	160	mW	

Notes:

a. Signals on NC, NO, or COM or IN exceeding  $V_+$  will be clamped by internal diodes. Limit forward diode current to maximum current ratings.

b. All leads welded or soldered to PC Board.

c. Derate 2.0 mW/ $^\circ\text{C}$  above  $70^\circ\text{C}$ .

SPECIFICATIONS (V+ = 3 V)							
Parameter	Symbol	Test Conditions Otherwise Unless Specified V+ = 3 V, ± 10 %,VIN = 0.4 V or 2.0 V <sup>e</sup>	Temp <sup>a</sup>	Limits - 40 to 85 °C			Unit
				Min <sup>b</sup>	Typ <sup>c</sup>	Max <sup>b</sup>	
Analog Switch							
Analog Signal Range <sup>d</sup>	VNO, VNC, VCOM		Full	0		V+	V
On-Resistance	rON	V+ = 2.7 V, VCOM = 0.5 V/1.5 V INO, INC = 100 mA	Room		1.4	1.7	Ω
rON Match	ΔrON		Full			1.9	
rON Flatness	rON Flatness		Room		0.3	0.4	
Switch Off Leakage Current <sup>f</sup>	INO(off) INC(off)	V+ = 3.3 V, VNO, VNC= 1 V/3 V, VCOM = 3 V/1 V	Room	- 2		2	nA
			Full	- 20		20	
	ICOM(off)		Room	- 2		2	
			Full	- 20		20	
Channel-On Leakage Current <sup>f</sup>	ICOM(on)	V+ = 3.3 V, VNO, VNC = VCOM = 1 V/3 V	Room	- 2		2	
			Full	- 20		20	
Digital Control							
Input High Voltage	VINH		Full	1.6			V
Input Low Voltage	VINL		Full			0.4	
Input Capacitance	Cin		Full		4		pF
Input Current	IINL or IINH	VIN = 0 or V+	Full	1		1	μA
Dynamic Characteristics							
Turn-On Time	tON	V+ = 2.7 V, VNO or VNC = 1.5 V, RL = 50 Ω, CL = 35 pF	Room		18	43	ns
Turn-Off Time	tOFF		Full		7	32	
Break-Before-Make Time	tBBM		Full		34		
Charge Injection <sup>d</sup>	QINJ	CL = 1 nF, VGEN = 0 V, RGEN = 0 Ω	Room		3		pC
Off-Isolation <sup>d</sup>	OIRR	RL = 50 Ω, CL = 5 pF, f = 1 MHz	Room		- 58		dB
Crosstalk <sup>d</sup>	XTALK		Room		- 64		
NO, NC Off Capacitance <sup>d</sup>	CNO(off) CNC(off)	VIN = 0 or V+, f = 1 MHz	Room		21		pF
Channel-On Capacitance <sup>d</sup>	CON		Room		61		
Power Supply							
Power Supply Range	V+			1.8		5.5	V
Power Supply Current	I+	VIN = 0 or V+			0.01	1.0	μA



SPECIFICATIONS (V+ = 5.0 V)							
Parameter	Symbol	Test Conditions Otherwise Unless Specified V+ = 5.0 V, ± 10 %, V <sub>IN</sub> = 0.6 V or 1.8 V <sup>e</sup>	Temp <sup>a</sup>	Limits - 40 to 85 °C			Unit
				Min <sup>b</sup>	Typ <sup>c</sup>	Max <sup>b</sup>	
Analog Switch							
Analog Signal Range <sup>d</sup>	V <sub>NO</sub> , V <sub>NC</sub> , V <sub>COM</sub>		Full	0		V+	V
On-Resistance	r <sub>ON</sub>	V+ = 4.5 V, V <sub>COM</sub> = 0.5 V/2.5 V, I <sub>NO</sub> , I <sub>NC</sub> = 100 mA	Room Full		1	1.3 1.45	Ω
r <sub>ON</sub> Match	Δr <sub>ON</sub>		Room			0.15	
r <sub>ON</sub> Flatness	r <sub>ON</sub> Flatness		Room		0.3	0.4	
Switch Off Leakage Current	I <sub>NO(off)</sub> I <sub>NC(off)</sub>	V+ = 5.5 V, V <sub>NO</sub> , V <sub>NC</sub> = 1 V/4.5 V, V <sub>COM</sub> = 4.5 V/1.0 V	Room Full	- 2 - 20		2 20	nA
	I <sub>COM(off)</sub>		Room Full	- 2 - 20		2 20	
Channel-On Leakage Current	I <sub>COM(on)</sub>	V+ = 5.5 V, V <sub>NO</sub> , V <sub>NC</sub> = V <sub>COM</sub> = 1.0 V/4.5 V	Room Full	- 2 - 20		2 20	
Digital Control							
Input High Voltage	V <sub>INH</sub>		Full	1.8			V
Input Low Voltage	V <sub>INL</sub>		Full			0.6	
Input Capacitance	C <sub>in</sub>		Full		4		pF
Input Current	I <sub>INL</sub> or I <sub>INH</sub>	V <sub>IN</sub> = 0 or V+	Full	1		1	μA
Dynamic Characteristics							
Turn-On Time	t <sub>ON</sub>	V <sub>NO</sub> or V <sub>NC</sub> = 2.5 V, R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 35 pF	Room Full		11	35 39	ns
Turn-Off Time	t <sub>OFF</sub>		Room Full		6	31 33	
Break-Before-Make Time	t <sub>BBM</sub>		Room	1	5		
Charge Injection <sup>d</sup>	Q <sub>INJ</sub>	C <sub>L</sub> = 1 nF, V <sub>GEN</sub> = 0 V, R <sub>GEN</sub> = 0 Ω	Room		14		pC
Off-Isolation <sup>d</sup>	OIRR	R <sub>L</sub> = 50 Ω, C <sub>L</sub> = 5 pF, f = 1 MHz	Room		- 58		dB
Crosstalk <sup>d</sup>	X <sub>TALK</sub>		Room		- 64		
N <sub>O</sub> , N <sub>C</sub> Off Capacitance <sup>d</sup>	C <sub>NO(off)</sub> C <sub>NC(off)</sub>	V <sub>IN</sub> = 0 or V+, f = 1 MHz	Room		19		pF
Channel-On Capacitance <sup>d</sup>	C <sub>ON</sub>		Room		61		
Power Supply							
Power Supply Range	V+	V <sub>IN</sub> = 0 or V+		1.8		5.5	V
Power Supply Current	I+				0.01	1.0	μA

Notes:

a. Room = 25 °C, Full = as determined by the operating suffix.

b. The algebraic convention whereby the most negative value is a minimum and the most positive a maximum, is used in this data sheet.

c. Typical values are for design aid only, not guaranteed nor subject to production testing.

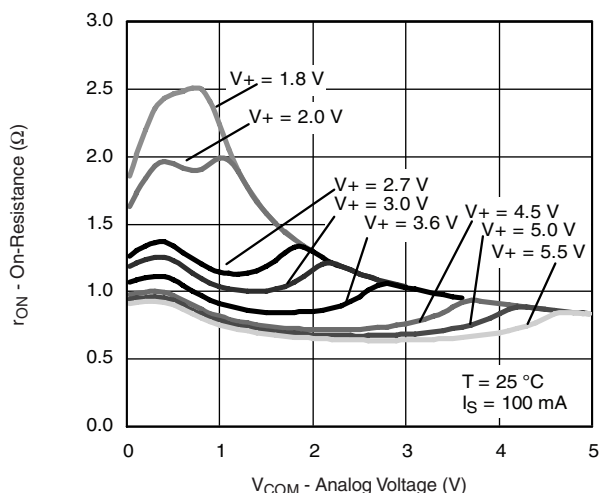
d. Guarantee by design, nor subjected to production test.

e. V<sub>IN</sub> = input voltage to perform proper function.

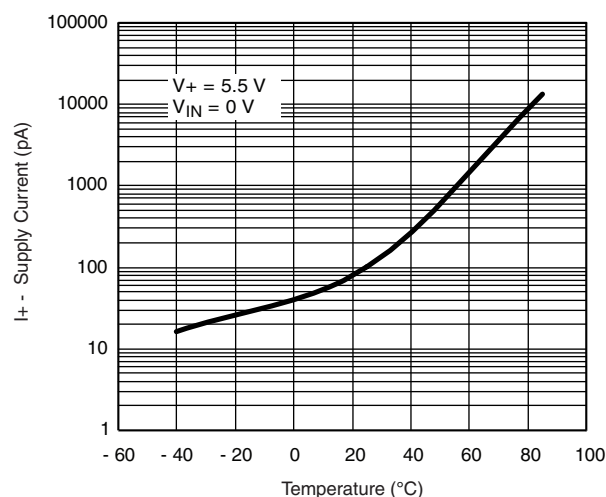
f. Guaranteed by 5 V leakage testing, not production tested.

Stresses beyond those listed under "Absolute Maximum Ratings" may cause permanent damage to the device. These are stress ratings only, and functional operation of the device at these or any other conditions beyond those indicated in the operational sections of the specifications is not implied. Exposure to absolute maximum rating conditions for extended periods may affect device reliability.

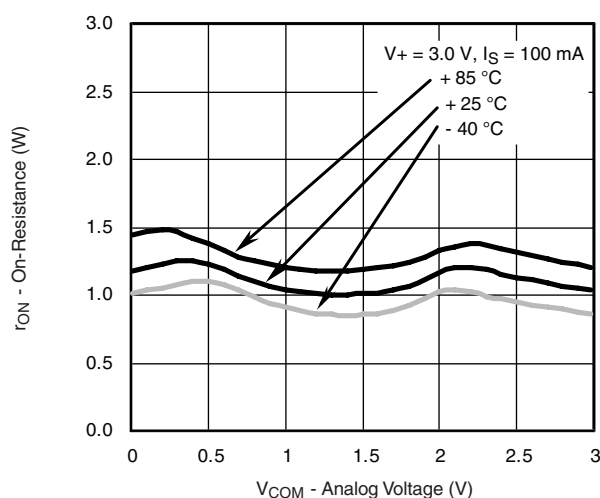
## TYPICAL CHARACTERISTICS $T_A = 25^\circ\text{C}$ , unless otherwise noted



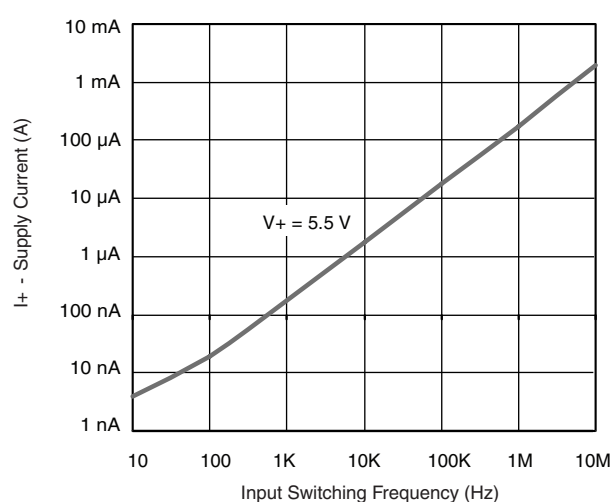
$r_{ON}$  vs.  $V_{COM}$  and Supply Voltage



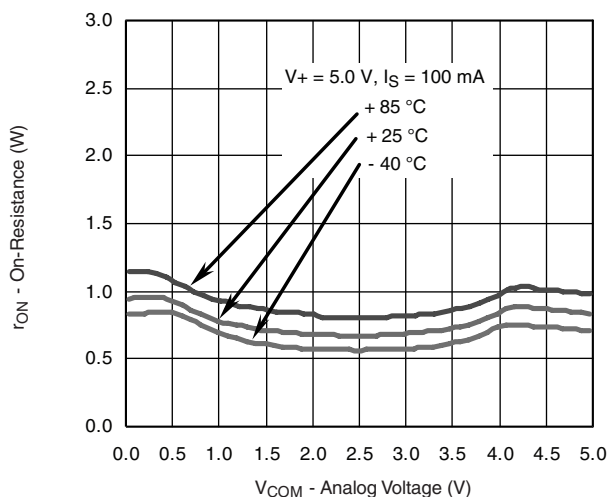
Supply Current vs. Temperature



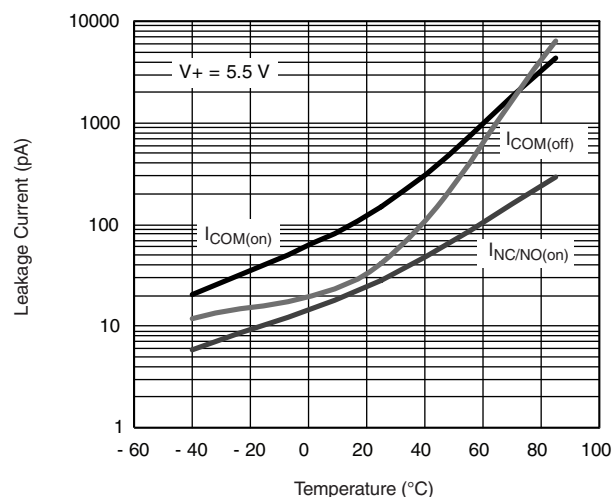
$r_{ON}$  vs. Analog Voltage and Temperature



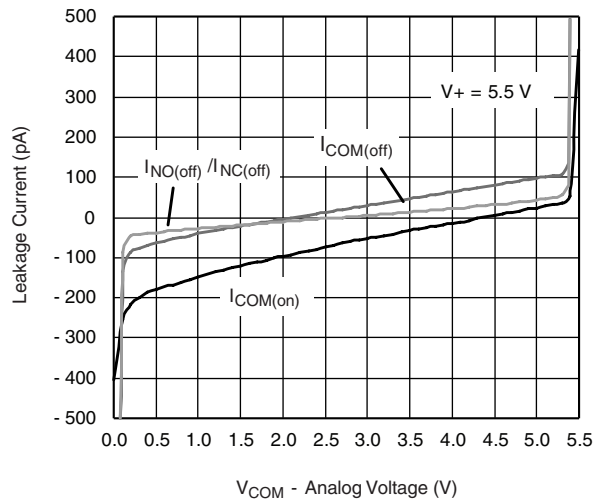
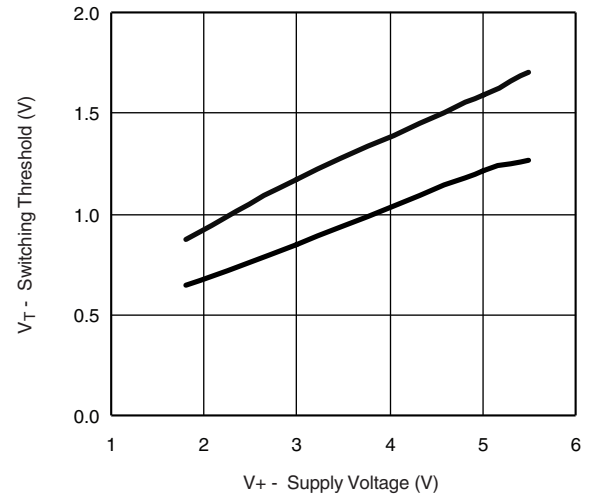
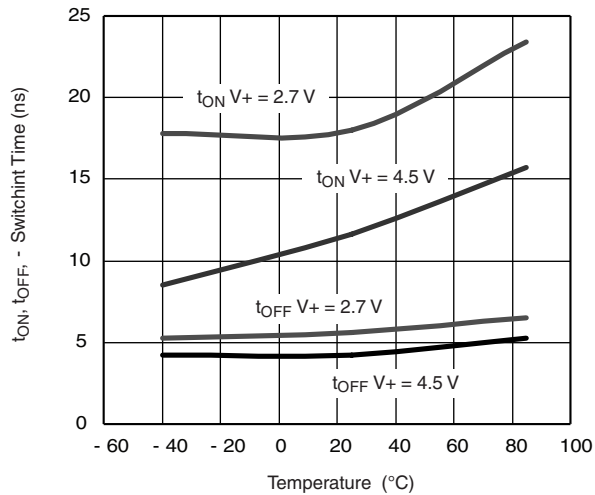
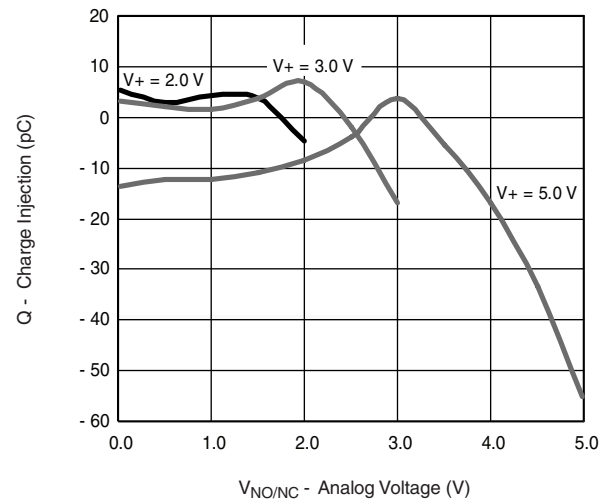
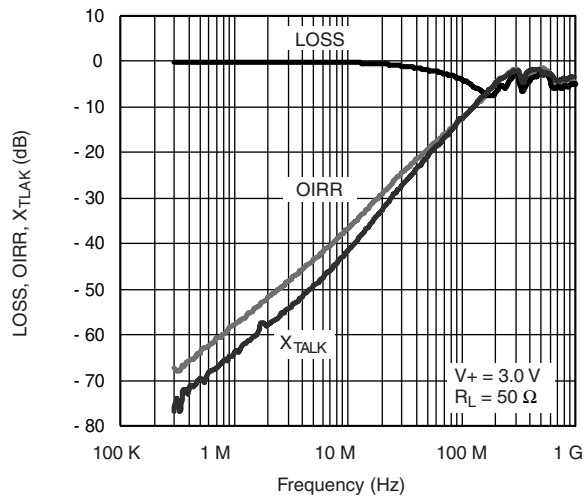
Supply Current vs. Input Switching Frequency



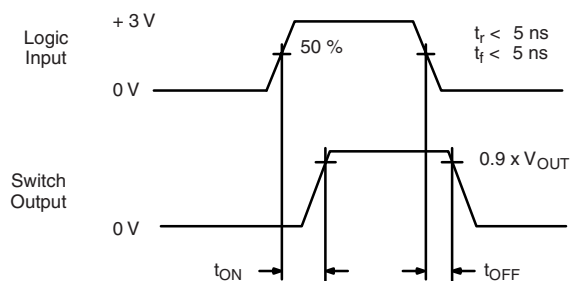
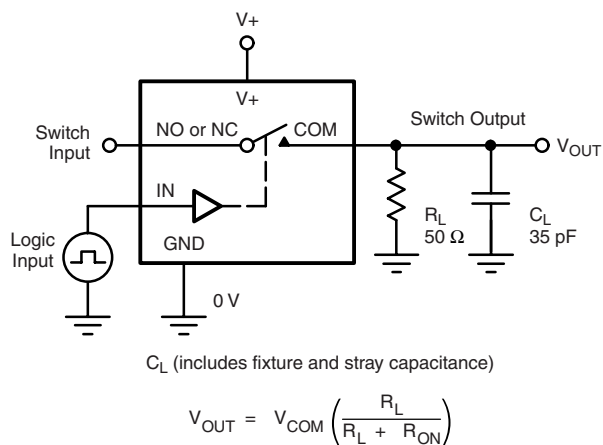
$r_{ON}$  vs. Analog Voltage and Temperature



Leakage Current vs. Temperature

**TYPICAL CHARACTERISTICS**  $T_A = 25^\circ\text{C}$ , unless otherwise noted

**Leakage vs. Analog Voltage**

**Switching Threshold vs. Supply Voltage**

**Switching Time vs. Temperature and Supply Voltage**

**Charge Injection vs. Analog Voltage**

**Insertion Loss, Off-Isolation, Crosstalk vs. Frequency**

## TEST CIRCUITS



Logic "1" = Switch On  
Logic input waveforms inverted for switches that have the opposite logic sense.

Figure 1. Switching Time

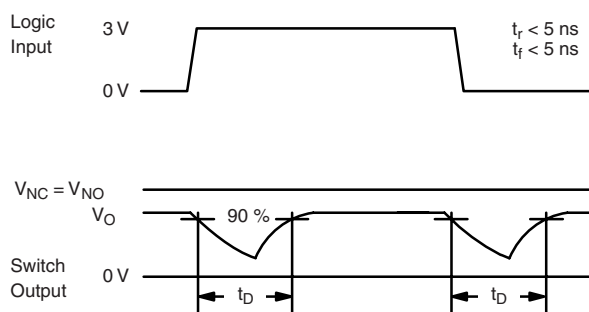
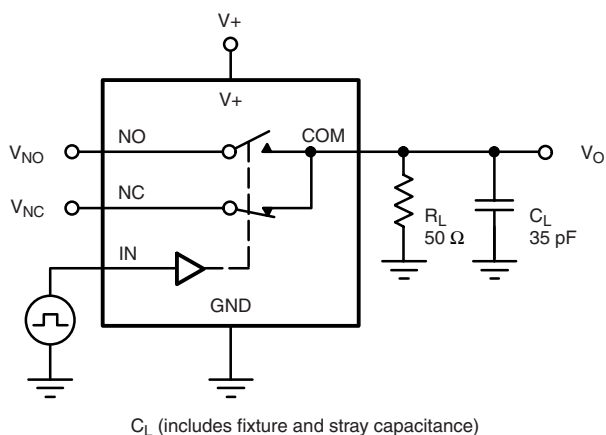
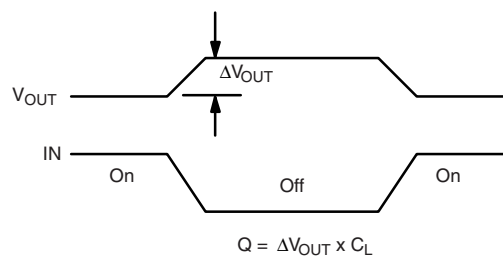
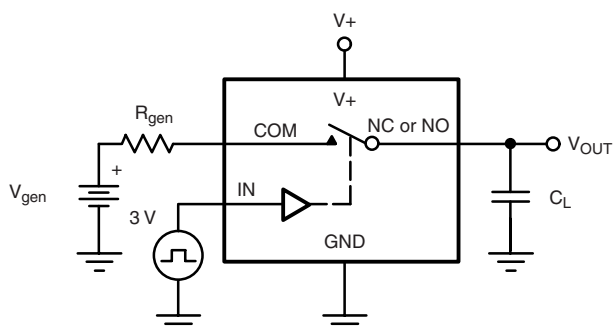
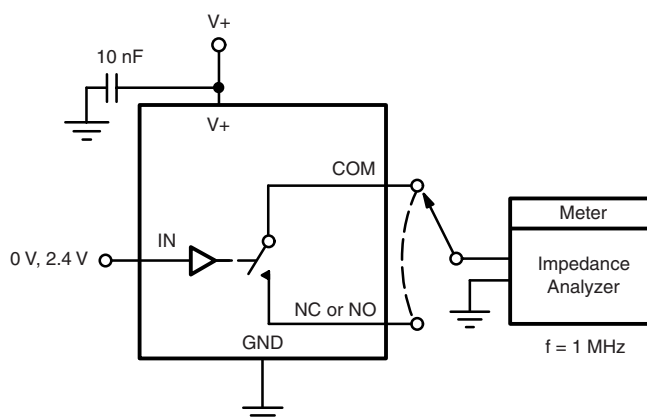
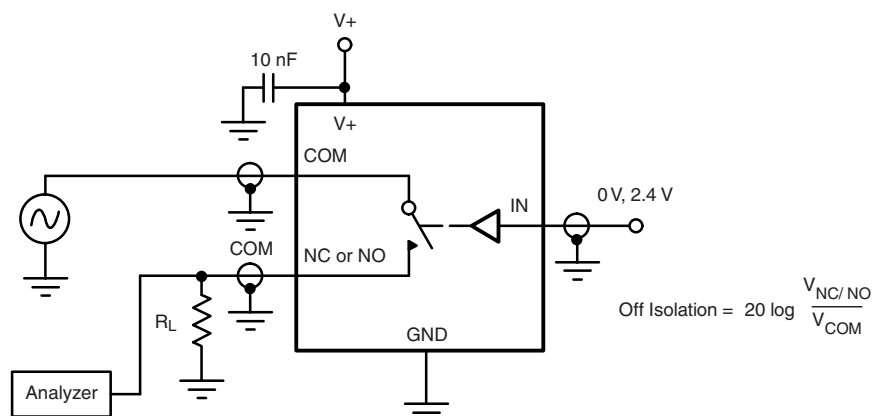


Figure 2. Break-Before-Make Interval



IN depends on switch configuration: input polarity determined by sense of switch.

Figure 3. Charge Injection

**TEST CIRCUITS**


Vishay Siliconix maintains worldwide manufacturing capability. Products may be manufactured at one of several qualified locations. Reliability data for Silicon Technology and Package Reliability represent a composite of all qualified locations. For related documents such as package/tape drawings, part marking, and reliability data, see <http://www.vishay.com/ppg?74454>.



### Disclaimer

All product specifications and data are subject to change without notice.

Vishay Intertechnology, Inc., its affiliates, agents, and employees, and all persons acting on its or their behalf (collectively, "Vishay"), disclaim any and all liability for any errors, inaccuracies or incompleteness contained herein or in any other disclosure relating to any product.

Vishay disclaims any and all liability arising out of the use or application of any product described herein or of any information provided herein to the maximum extent permitted by law. The product specifications do not expand or otherwise modify Vishay's terms and conditions of purchase, including but not limited to the warranty expressed therein, which apply to these products.

No license, express or implied, by estoppel or otherwise, to any intellectual property rights is granted by this document or by any conduct of Vishay.

The products shown herein are not designed for use in medical, life-saving, or life-sustaining applications unless otherwise expressly indicated. Customers using or selling Vishay products not expressly indicated for use in such applications do so entirely at their own risk and agree to fully indemnify Vishay for any damages arising or resulting from such use or sale. Please contact authorized Vishay personnel to obtain written terms and conditions regarding products designed for such applications.

Product names and markings noted herein may be trademarks of their respective owners.